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RELIGIOUS AND MYSTICAL EXPERIENCES AS ARTIFACTS OF TEMPORAL LOBE FUNCTION: A GENERAL HYPOTHESIS

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Summary.—Mystical and religious experiences are hypothesized to be evoked by transient, electrical microseizures within deep structures of the temporal lobe. Although experiential details are affected by context and reinforcement history, basic themes reflect the inclusion of different amygdaloid-hippocampal structures and adjacent cortices. Whereas the unusual electrical coherence allows access to infantile memories of parents, a source of god expectations, specific stimulation evokes out-of-body experiences, space-time distortions, intense meaningfulness, and dreamy scenes. The species-specific similarities in temporal lobe properties enhance the homogeneity of cross-cultural experiences. They exist along a continuum that ranges from "early morning highs" to recurrent bouts of conversion and dominating religiosity. Predisposing factors include any biochemical or genetic factors that produce temporal lobe lability. A variety of precipitating stimuli provoke these experiences, but personal (life) crises and death bed conditions are optimal. These temporal lobe microseizures can be learned as responses to existential trauma because stimulation is of powerful intrinsic reward regions and reduction of death anxiety occurs. The implications of these transients as potent modifiers of human behavior are considered.

The neuropsychological basis of religious experiences and God beliefs has been avoided by behavioral scientists. Yet these experiences, in conjunction with the confrontation and attenuation of death anxiety, constitute a major class of human behaviors whose frequency is rivaled only by sex and aggression. This paper briefly describes a general hypothesis that religious and mystical experiences are *normal* consequences of spontaneous biogenic stimulation of temporal lobe structures. The numbers, composition, and intensity of these experiences reflect a continuum of temporal lobe stability. Each human being may be located somewhere along this dimension.

The temporal lobe of the human brain is an optimal locus for the creation of religious experiences. Cortical and deep structures (primarily the amygdaloid and hippocampal complexes) are associated with the sense of "self" in relationship to time and space, the memory-dependent conception of their limits and the primary affective components of anticipation, especially of nociceptive events. Given copious inputs from languaging centers (Gloor, 1972), all of these experiences are influenced by suggestion and by the rich imagery-evoking

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sequences of metaphorical language. It is not surprising that anticipation of self-dissolution, death anxiety, would emerge within this context.

Deep telencephalic structures have acquired particular importance in human development. Experiences of self and the propensity for self-preservation have been elaborated upon the general amygdaloid role of hypothalamic modulation. The amygdala contains representations of motivational states and their affective (pleasure or reward versus pain or punishment) dimensions. Whereas crude (and wide spread) stimulation evokes fear (Weingarten, Cherlow, & Holmgren, 1977) and general anxiety (anticipation of negative stimuli), more subtle stimulation evokes intense meaningfulness and peak experiences; the latter are often in conjunction with altered body perceptions, such as out-of-body experiences (Jasper & Rasmussen, 1958) or convictions of cosmic communion.

Intricate and highly organized connections between deep structures and the overlying associative cortices allow complex memories and language to control the evocation of amygdaloid experiences. Consequently, they can be infused with the details of context and determined by the expectancy of the person. Plentiful opiate receptor sites in this portion of the amygdala and along the temporal pole (Pay, 1982) allow positive experiences to be influenced by a chemical dimension that ranges from synthetic substances (morphine derivatives) to the enkephalin physiology of life crises.

Considering the direct connections to the dorsomedial portions of the thalamus and orbital frontal lobes, time distortions (e.g., viewing eternity in a split second) would not be unexpected. Sudden amygdaloid stimulation and alteration of the sense of self in space-time could momentarily alter hippocampal function and change memory reference. The alteration may range from institution of memories that appear to be "old and real" to the conviction that something meaningful and intensely personal has happened (although the details are vague). A significant portion of them would be characterized by a long latency between the time of the experience and its report.

Three important physiological properties target the temporal lobe as the source of mystical/religious experiences. Post-stimulation electrical instability, an intrinsic feature of deep structures, allows the creation of transient neuronal firing patterns that do not necessarily represent concurrent sensory input. Instead, they could incorporate combinations of memory and fantasy, but still within the context of the moment. This region is well known for its capacity to generate learned seizures (kindling); antithetically, conditioned inhibition of seizure patterns is also predictable and has been observed (Efron, 1957).

Second, these areas are prone to vascular anomalies such as transient vasospasms. They are now considered a primary cause of hallucinatory experiences (Altura & Altura, 1981). The recent evolutionary changes in the relative position of Ammon's horn, including the formation of an extra gyrus to accom-

modate this development, has fostered vasospasmogenic potential due to the odd cytoarchitecture. This is enhanced by the conspicuous coronal asymmetry of the Sylvian fissures (LeMay, 1982) which contribute to unusual electrical discrepancies between the two hemispheres.

The plasticity of temporal lobe neuronal and glial populations are exceptional. Cellular membranes in this region are prone to both interneuronal and neuronal-glial fusion, an important predisposing factor to psychomotor epilepsy (Schwartzkroin, 1983); within less extreme conditions, it aids unusual mixtures of cell ensembles. They can be affected by vitamin B deficiencies, hormonal fluctuations, hypoglycemia, hypoxia, and tumorogenesis, to which these structures are particularly sensitive (Breggin, 1979). Although postnatal neurogenesis has not been clearly demonstrated in man, this area displays environmental-dependent alterations in dendritic arborbization that are evident even by light microscopy (Buell & Coleman, 1979).

According to the hypothesis, the actual mystical or religious experience is evoked by a transient (a few seconds), very focal, electrical display within the temporal lobe. Such *temporal lobe transients* (TLTs) would be analogous to electrical microseizures without any obvious motor components; some facial expressions, such as ecstasy and occasional lacrimation would be noticeable. Lip smacking, facial distortions, automatisms, and vagal glossopharyngeal-mediated vocalization (speaking in tongues), followed by amnesia, would occur in more extreme conditions. Although most TLTs should be subcortical in origin, some would be represented within electroencephalic (EEG) profiles. They would be characterized by local, perhaps even lead-specific, transient, seizure-like signatures surrounded by normal activity.

Experiential details of the TLT would be influenced by the specific environmental context (church versus public place), the label paired with the experience (god versus cosmic consciousness) and the relative inclusion of reward (good: heaven) versus aversive (bad: hell) neuronal centers. Since normal TLTs are biogenic, they will be brief, quickly attenuated in brain space and easily accommodated into experience. More elaborate or bizarre components, especially fear or the sense of evil, would occur in widespread TLTs due to ectopic neuronal connections (as in the epileptic-prone brain) or to unusually intense external stimulation by brain frequency electromagnetic fields (Persinger, 1983). Stimuli that are not typically detected by the person may be registered during TLTs.

Although the content of TLT experiences would reflect the person's learning history (referencing Allah versus Jehovah), the general pattern of themes would be consistent across every human culture due to the *similarities of temporal lobe function.* Persistent patterns of reported experience would be due to electrical coherence (Brazier, 1972) through which structures, typically not

coordinated, display brief interaction. Systematic access to: (1) infantile memories of parental images (perhaps even perinatal representations of proprioception), and (2) images from before four to five years of age and memories for which there are no retrieval formats, could occur. Both would be attributed to extrinsic ("ego-alien") sources (Mahl, Rothenberg, Delgado, & Hamlin, 1964), and be incorporated within experiences that share similar neuroelectrical patterns. The former would be a universal source of God (parent surrogate) images while the latter would foster conclusions of "previous lives" or "other memories."

Complex sequences are influenced simply by the numbers of structures incorporated into the TLTs. Since they are primarily positive experiences, the responsible neuronal aggregates should be near fields of reward neurons. To some extent, all of these experiences have been evoked, in a fragmented manner, by crude surgical stimulation (Gloor, 1972; Horowitz & Adams, 1970). They include out-of-body experiences (mental diplopia), vestibular sensations (spinning through time-space), auditory experiences (rushing sounds, the voice of god or a spirit creature giving instructions), perceptual alterations (looking down a tunnel; bright lights), and peacefulness. Like direct intracranial stimulation, the experiences may be perceived in a dream atmosphere. Since neuronal ensembles associated with the "sense of self" are also recruited, TLTs have great personal significance whose privacy is protected.

The hypothesis predicts that there exists a temporal lobe syndrome containing experiential aggregates that reflect its function (Ervin, 1975). Repeated, intense hallucinogenic TLTs should be followed by and reciprocal to delusions (Weinstein, 1970). Extreme and bizarre symptoms, such as circumstantiality, a sense of the personal (egocentric references; divine guidance), viscosity (perseveration), hypergraphia (diary writing), altered affect, and, of course, a dominating religiosity occupy one of the continuum. They would be evident as interictal behaviors in populations with various stages of temporal lobe epilepsy (Geschwind, 1983) or temporal lobe psychosis (Bear & Fedio, 1977).

Less severe displays, which are woven within the dynamics of borderline or "soft" temporal lobe signs and do *not* involve disorders in thought processes, constitute the central region of the scale. Typical symptoms would include: early morning highs (0200 to 0400 hr.), déja-vu experiences, vibration sensations before sleeping, "waves of energy permeating the body," recurrent vivid dreams, intense meaningfulness after reading material about unusual or unexpected situations, feelings of unreality (depersonalization), peaceful or quiescent episodes of diffuse concentration, memory blanks, experiencing the presence of other beings, the special personal significance of chance events, and the distortions in serial order of events (telepathic/precognitive experi-

ences). *They are normal responses*; only their frequency or duration of occurrence and the degree to which they dominate the person's behavior predict the potential pathology.

A variety of predisposing factors would determine each person's initial position along the temporal lobe continuum. People whose brains are prone to membrane fusion and to recurrent low-level epileptogenic foci, would be particularly sensitive. Ontogenic changes alter this probability. Major peaks in the occurrence of religious/mystical experiences occur around pubescence, as indicated by normal temporal lobe peculiarities during this period (Kiloh, McComas, & Osselton, 1972), and later during the deterioration of geriatric progression. However, any condition that increases deep structure lability, including cultural practices or racial by cultural interactions, are important predisposing factors for TLTs.

The more intense the precipitating agent in general, the more complex and vivid the TLT experience. A range of precipitating factors exist. Less severe and mundane stimuli include fatigue, social isolation, peaks (early morning) or shifts (travel) in circadian rhythms, musical stimuli, smells (incense), and vestibular (rocking) stimuli. They could be combined in various patterns but their efficacy would be dominated by the learned or physiological propensity to statistically stimulate relevant temporal lobe structures. Intermediate stimuli, which could be singularly effective, include hypoglycemia (fasting), hypoxia ("mountain top reveries"), certain psychedelic drugs, intense pain (including child birth), and direct stimulation of peripheral limbic afferents, such as the sciatic nerve, by exotic procedures (yoga positions).

Two life crises, the anticipation of self-demise and the loss of a loved one, are notorious biochemical disruptors that particularly influence TLT probability. Whereas the former increases with age (as death becomes imminent) and generates frank religious experience (such as hearing God state, "you will live forever"), the latter schedule changes are followed by sequences that are more directly related to the lost person (postmortem apparition reports). Both types of events are hallucinatory solutions (Bauer, 1970) to the problem; they appear extraordinarily real and very personal.

The psychophysiological correlates of near-death conditions should be the strongest precipitators of TLTs. Progressive alteration in blood flow and transient vasospasms in key areas, accentuated by the gradual deterioration of the body or by surgical procedures (anesthesia), allow prolonged and optimal temporal lobe conditions. Unlike some presumptions (Grosso, 1981), a flat EEG reflects cortical activity and would not necessarily measure TLTs within deep structures. That they are electrically responsive to environmental stimuli is evident even in normal spindle and deep sleep. However, attentuation of cortical contributions would highlight the shared characteristics of these por-

tions of the human brain and increase the homogeneity of the reported experience across human cultures (Shiels, 1978). Controlling for cultural expectations (Osis, 1961), death bed experiences should be influenced by drugs that affect amygdaloid receptor sites (morphine) or vasospasm (verapamil).

There is no doubt that TLTs can be conditioned since they are intrinsically rewarding experiences; they can be considered learned microseizures provoked by precipitating stimuli and followed by anxiety reduction. People whose brains are prone to self-stimulation would be characterized by multiple conversions and protracted periods of religious/mystical experiences; the latter is not unusual in populations of temporal lobe psychotic patients (Slater & Beard, 1963). Because of the intensity of TLT reward, any antecedent conditions could become strong secondary reinforcers. In more pathological cases, personal adversity or crisis may become rewarding since they are followed persistently by the TLT high. Such individuals would be prone to periodic bouts of conversion mania, rededications, and repeated "cult jags" (Persinger, Carrey, & Suess, 1980).

All cultures contain techniques that facilitate the controlled occurrence of TLTs; most have been selected and maintained on the basis of their consequences: mystical experiences. Behavioral operations that optimize the more blatant symptoms of temporal lobe instability, include forced thinking (mantras), repetition of sounds, alteration of normal sensory modalities, relaxation, and even dietary changes in tryptophan or pyridoxal phosphate (Ervin, 1975). Unique and specific situations, such as nonsense words, foreign languages, special phrases or even particular places or people, are potent discriminative stimuli. The many facets of group camaraderie are particularly effective. However metaphorical language is the most profuse precursor to TLTs.

Given the profound capacity to evoke pleasurable and meaningful experiences, reduce existential anxiety and generate the security of old parental experiences (the origin of god images), TLTs are potent modifiers of human behavior. A singular episode, in the appropriate context, can be followed by long-term behavioral changes. The threat of removal of these experiences or the challenge of their construct validity, is an obvious source of anxiety. Since behavioral scientists are also human beings, it is not surprising that the persual of a neuropsychological basis to religious experiences has been conspicuously avoided by them.

The necessity for TLT generation probably paralled the capacity for abstract anticipation during the development of the frontal lobe. Without the emergence of TLTs as anxiety buffers against the ubiquitous threat of self-extinction, the elaboration and maintenance of the neural patterns responsible for the human sense of self may have been impeded. Although this development had broad evolutionary significance, its continuation within contemporary human behavior is ominous.

If TLTs are the source of religious experiences, then three immediate issues become relevant. First, these portions of the brain are also correlated with bursts of aggression (Geschwind, 1983); since the sense of personal meaningfulness is an intricate component of religious experiences, is there a genetic propensity to kill with the conviction of cosmic consent following specific types of TLTs? Second, many acute religious behaviors are correlated with opiate-like complacency, helplessness, and the expectation of divine deliverance; how would the decision-making patterns of people who occupy powerful political positions be influenced by TLTs during the threat of self-annihilation? Third, if TLTs are primarily biogenic neuropatterns, they will be simulated, ultimately, by modern technology. If they can be evoked by artificial methods, what are the clinical implications for the control of religious experiences? These questions are immediate derivations of the hypothesis.

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